

SATCOM for Net-Centric Warfare

MilsatMagazine

September 2020 issue

"Communications-On-The-Move (COTM) via satellite allows ubiquitously empowered warfighters." — Robert Rigsby

Image is courtesy of SES-GS, GSR



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SENIOR COLUMNISTS

Chris Forrester, Broadgate Publications
Karl Fuchs, iDirect Government Services
Bob Gough, Goonhilly Earth Station
Rebecca M. Cowen-Hirsch, Inmarsat
Ken Peterman, Viasat
Giles Peeters, Track24 Defence
Koen Willems, Newtec

THIS ISSUE'S AUTHORS

Shawn Cochran
Karl Fuchs
Kevin Lausten
Robert Rigsby
Mark Roberts

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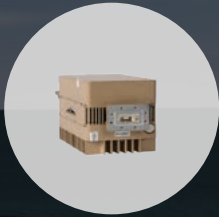
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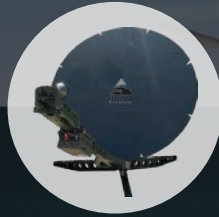
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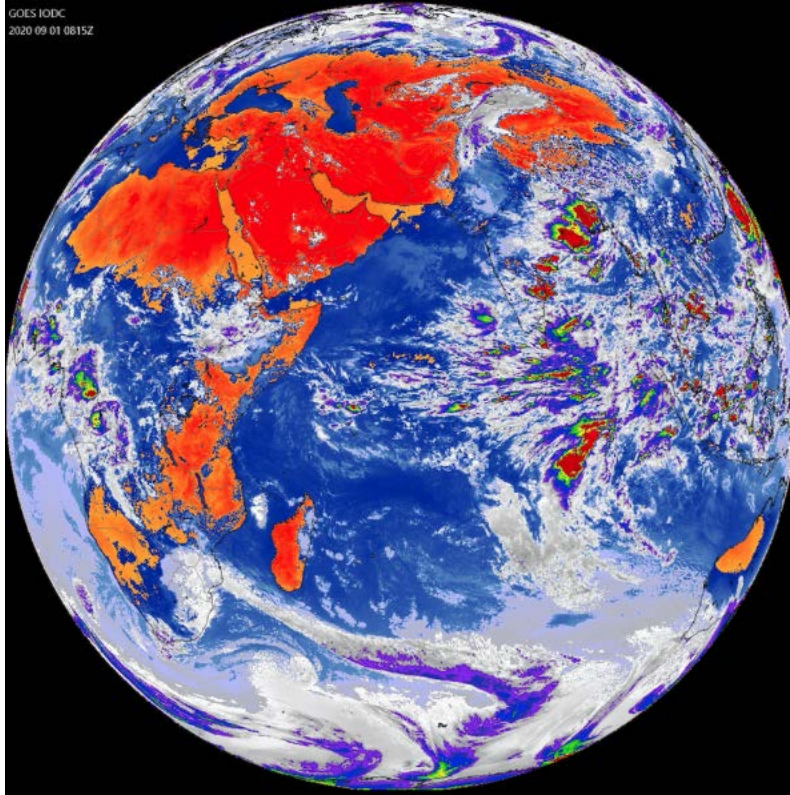
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USSF AND NOAA BEGIN JOINT OPERATIONS OF INFRARED WEATHER SATELLITE



A view of the Earth from the EWS-G1 satellite taken on September 1, 2020.

Originally launched in 2006 as GOES-13, the satellite provided operational weather coverage over the United States' East Coast for 10 years before being replaced in the GOES-East position by GOES-16. The transfer to the Department of Defense and relocation of EWS-G1 is the culmination of joint efforts between SMC, NOAA and NASA.

Photo courtesy of U.S. Space Force's MARK IV-B Program Office.

The U.S. Space Force has declared Initial Operational Capability of the Electro-optical Infrared Weather System Geostationary (EWS-G1) spacecraft. EWS-G1, formerly known as GOES-13, was transferred to the U.S. Air Force by the National Oceanic and Atmospheric Administration (NOAA) in 2019 under an agreement between the U.S. Air Force and NOAA for Interagency Cooperation on Collection of Space-Based Environmental Monitoring Data.

Originally launched in 2006, GOES-13 provided operational weather coverage over the United States East Coast for 10 years before being replaced in the GOES-East position by GOES-16.

EWS-G1 is the first Department of Defense owned geostationary weather satellite.

The satellite provides timely cloud characterization and theater weather imagery to DoD in the Indian Ocean region, addressing needs across Central Command (CENTCOM) and other operating theaters.



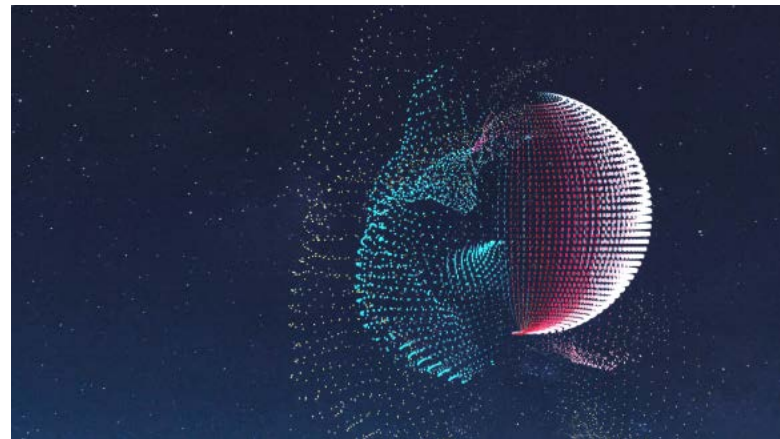
The transfer and relocation of EWS-G1 is the culmination of joint efforts between the USSF's Space and Missile Systems Center, NOAA and National Aeronautics and Space Administration.

"EWS-G1 is a prime example of innovation and the leveraging of partnerships. SMC partnered with NOAA and NASA to deliver critically needed Geostationary visible and infrared cloud characterization and theater weather imagery in the Indian Ocean region. This effort demonstrates speed by allowing the spacecraft to be moved and operated in the Indian Ocean region far earlier than a new satellite could be produced and fielded," said Charlotte Gerhart, SMC's Production Corps Low Earth Orbit Division Chief. "The repurposing of GOES-13, and residual NOAA ground equipment, accomplished the mission at a fraction of the procurement cost of a brand new system."

After the relocation maneuver, NOAA and the U.S. Space Force completed a thorough checkout of the EWS-G1 spacecraft and sensors. All criteria were met to declare the system operational and EWS-G1 is now providing weather data to DoD forecasters.

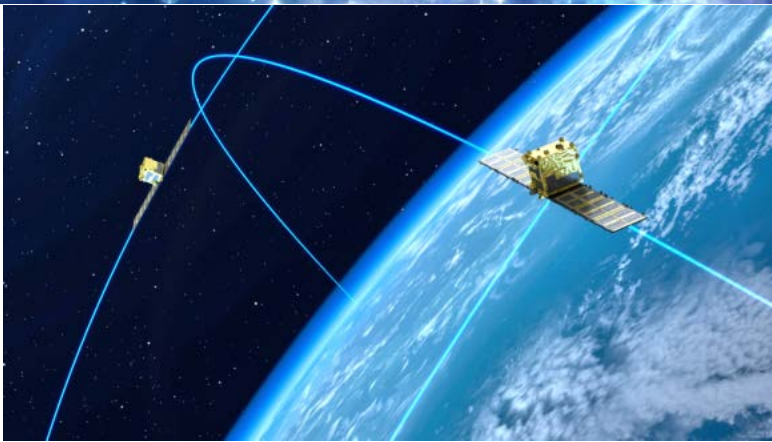
NOAA will continue to operate EWS-G1 on behalf of the U.S. Space Force for its remaining life span, from the NOAA Satellite Operations Facility in Suitland, Maryland and Wallops Command and Data Acquisition Station in Virginia.

SAR-BASED LAND DISPLACEMENT MONITORING SERVICE ROLLS OUT FROM SYNSPECTIVE



Synspective Inc. has launched their first "Land Displacement Monitoring" service that enables ground movement monitoring in millimeters, obtained through image analysis of SAR (Synthetic Aperture Radar) satellites data.

The "Synspective Land Displacement Monitoring" service originates from InSAR*2 analysis that is capable of detecting timely, vertical land displacement, in millimeters, over a wide area. This Service enables periodic observation and understanding of land subsidence and deformation.



It takes a lot of time and labor to understand the risk of land subsidence and landslides over a wide area. By leveraging Synspective's new service, cost and time is reduced, when compared to the traditional observation and control techniques associated with these ground change risks.

This new service's expected use is multifaceted and can be applied in many land risk management projects such as construction projects, airport maintenance projects, and subway development projects, among others. In addition, remote are/site surveying can be extremely relevant in disaster struck areas where human access is restricted or dangerous, or where social movement is restricted due to the recent COVID-19 virus impact.

Synspective offers this solution on a subscription basis through a SaaS(solution as a service) format and subscribers can access the platform without installing the software and are able to check the analysis results on the web. User-friendly UI/UX enables users to intuitively understand the analysis results without any prior knowledge of satellite data.

Capability and functionality of this service were tested through preliminary utilization projects with several companies and organizations, including through participation in a PoC project by Singapore Land Authority, a statutory board under the Ministry of Law of Singapore. Through the insights and lessons learned from this PoC project, further utilization models were developed. This project also provided Synspective with feedback for improvements to the service, which has been incorporated in the current release.

Solution services with Synspective's own SAR data Synspective plans to launch its own small

SAR satellite "StriX-α" in 2020. In the near future, the company can provide solutions with higher frequency and stable monitoring by use of data obtained from the firm's own SAR satellite constellation.

Executive Comment

Synspective's Solutions Development Department General Manager, *Tomoyuki Imaizumi*, said, "Land Displacement Monitoring will be Synspective's first official service. We plan to continuously improve the service based on user feedback and increase the frequency of monitoring by utilizing our own satellite constellation. We are also planning to develop services that combine user-owned data based on this service."

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R4 INTEGRATION RECEIVES INMARSAT GLOBAL XPRESS TYPE APPROVAL FOR KA-BAND INTEGRATED SYSTEM

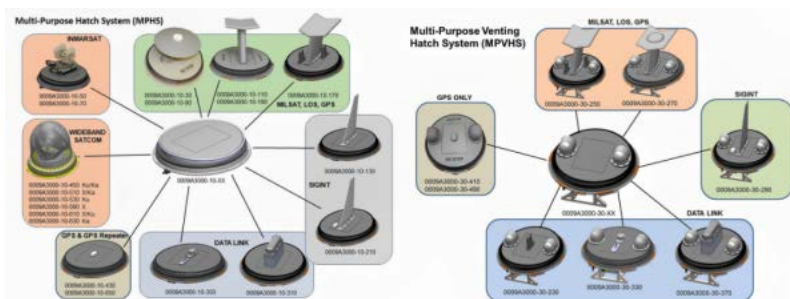


R4 Integration, Inc. (R4) has received Inmarsat type approval for the R4 C-130 Multi-Purpose Hatch System (MPHS) for use over the Inmarsat Global Xpress network.

In U.S. government operation since July 2014, Global Xpress develops reliable communications for land, air and sea ops for assured mobile connectivity and interoperability with government satellite systems.

The R4 MPHS is a low-profile, Ka-band integrated system that can be configured with virtually any type antenna or sensor that meets the size constraints of the MPHS. The system is fully interoperable with military Ka-band systems and optimized for use over the Global Xpress constellation.

Developed for mission-critical roll-on/roll-off requirements of the most demanding government special operations forces and other government customers, the MPHS accesses various Ka-band networks to provide enroute Command, Control, Computers, Communications, Cyber, Intelligence, Surveillance and Reconnaissance (C5ISR) support to airborne users on all C-130/L-100 aircraft variants.



DATA LINK SOLUTIONS

Executive Comments

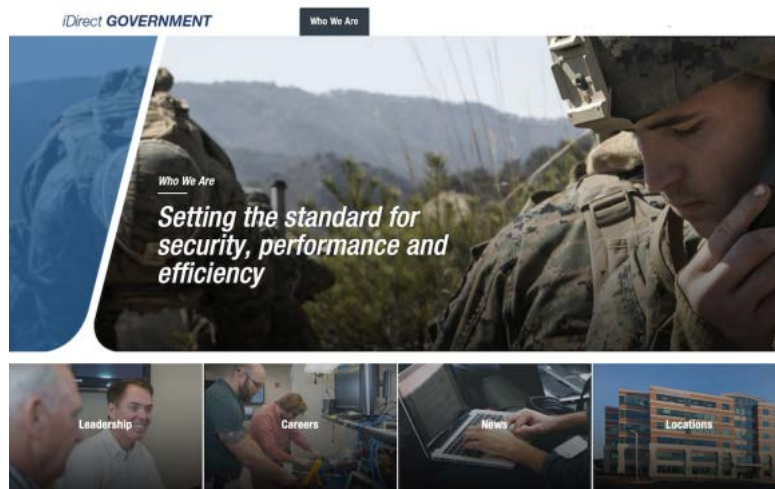
Steve Gizinski, President, Inmarsat Government, said, "The rapidly growing military, government and commercial customer adoption of Global Xpress is a testament to its exceptional assured global mobile connectivity and seamless interoperability with military satellite resources. With R4's MPHS, military



users now have a very compact, Roll-On/Roll-Off solution to support airborne critical communications-on-the-move connectivity requirements."

John Parsley, President of R4, noted, "Our smart, integrated, hybrid solution meets the fast-changing intel requirements of airborne forces. Inmarsat's Global Xpress provides the peak of seamless SATCOM-On-The-Move (SOTM) operability for mission-critical operations based on our MPHS solution."

IDIRECT GOVERNMENT FOR SECOND CONSECUTIVE YEAR IS WASHINGTON BUSINESS JOURNAL'S BEST PLACES TO WORK



iDirect Government (iDirectGov), provider of satellite communications to the military and government, announces that for the second consecutive year, has been named the Washington Business Journal's (WBJ) Best Places to Work for the large company category, ranking fourth on the list. The WBJ acknowledges the 100 Greater Washington, D.C., companies for their workplace excellence based on survey responses from their respective employees.

"We are honored to be recognized as one of the best places to work in the greater Washington, D.C., area for the second consecutive year," said **John Ratigan**, President of iDirect Government. "We built our company on strong, competent people who value our customers and work to make SATCOM and the supporting technological solutions viable for our military, homeland security, first responder and other government users.



"For our employees, coming to work every day is only the beginning. Gaining our customers' trust with top solutions supported with excellent customer service is the motto of every team member," he added. "Always envisaging to best address our customers' needs, we offer a wide array of support services, such as our Technical

Assistance Center with 24/7 support, on-site professionals who manage and support customer networks, and our engineers who help in designing SATCOM network plans. The collegial atmosphere and thought-provoking work make iDirectGov a best place to work."

The honorees are listed on the [Washington Business Journal](#) Lists.

KRATOS DEBUTS THEIR NEW WIDEBAND SOFTWARE RECEIVER — OPENSOURCE™



Kratos Defense & Security Solutions, Inc. (Nasdaq: KTOS) has launched their *OpenSpace™ Wideband Software Receiver* supporting the high data rates, scalability and interoperability needs of today's Earth Observation (EO) and Remote Sensing missions.

As more and more data is being beamed from satellites, the infrastructure on the ground must become highly flexible and more cost-effective to address the key challenge of EO applications – the need to rapidly download data on the fly during the short time periods when satellites are over the ground station.

Kratos' OpenSpace Wideband Software Receiver is the only completely virtual receiver with no Field Programmable Gate Array (FPGA) or Graphics Processing Unit (GPU). The software receiver takes advantage of virtual and cloud-based architectures and runs on standard x86 servers.

The OpenSpace Wideband Software Receiver offers 600 Mbps of throughput to support downlinks across several hundred MHz of instantaneous bandwidth, an unmatched level of signal processing in software. The performance of the OpenSpace Wideband Software Receiver is equivalent to hardware based EO and remote sensing receivers in the market.

Unlike traditional EO and remote sensing hardware that is proprietary and purpose built, the software-only receiver easily scales based on demand and embraces open standards including VITA 49 and CCSDS.

Leveraging technology used in Kratos' quantumRadio narrowband software receiver that supports tens of thousands of satellite passes per month, the OpenSpace Wideband Software Receiver offers the same virtual capabilities running on commodity compute resources, but with support for much wider bandwidths.

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The OpenSpace Wideband Software Receiver provides elastic demand with virtual instances to meet customer and changing mission needs. Virtual deployment of the software receiver enables government and commercial EO satellite operators to lower costs by using fewer proprietary and purpose-built hardware devices.

Kratos offers satellite operators and Ground Station as a Service (GSaaS) providers the ability to virtualize their infrastructure for EO and remote sensing service chains. After digitizing the RF at the antenna using Kratos' SpectralNet Wideband product, the digital stream is processed by the OpenSpace Wideband Software Receiver and the quantumDRA, Kratos' digital recording application, which stores the data for playback or streaming in real-time.

Executive Comments

According to **John Heskett**, CTO at Kongsberg Satellite Services (KSAT), "Our KSATlite global network takes advantage of a virtualized infrastructure including Kratos' narrowband software receiver, quantumRadio, to scale on demand delivering end-to-end services for customers. One gap that we have had in going fully virtualized is in our wideband demodulation and forward error correction signal processing which has been limited by the use of traditional hardware solutions that do not support virtualization. The OpenSpace Wideband Software Receiver offers the opportunity for us to move to a fully virtualized environment and to increase flexibility and resiliency in our operations."

"The OpenSpace Wideband Software Receiver dynamically adapts to meet the needs of EO and remote sensing data processing ground stations," explained **Chris Carlstrom**, Product Manager for Kratos. "The software receiver uses an all-digital processing chain optimized for performance and pass-to-pass configurability. It also easily fits into existing ground architectures and can be deployed on bare metal, virtual instances or in the cloud."

MCQ WINS AFWERX CONTRACT FOR USAF BASE SECURITY + DEFENSE VIA IRIIDIUM'S SATNET



AFWERX, the innovation program of the United States Air Force, initiated a *Base of the Future Challenge* to seek new technologies that greatly enhance the security and defense of Air Force Bases.

As the Air Force builds new and restores existing installations, they have the opportunity to examine and improve the existing security and defense systems that protect the people and critical resources they house. The focus areas of this challenge include Air Force bases with perimeters that require safeguarding from threats such as unauthorized or attempted illegal entry, active shooters, explosives, cyber risks and many other potential threats.

AFWERX received more than 1,500 submissions and accepted 374 proposals for the Challenge. **McQ** was down-selected in an initial group of 92 proposals followed by a virtual presentation by McQ of the firm's "Global Multi Domain Security and Base Defense" solution. Based on the presentation, McQ was selected to receive direct-to-contract authorization under the RAPIDx Commercial Solutions Opening (CSO) AFWERX program.

With the Base of the Future initiative, the U.S. Air Force (USAF) has an opportunity to start from the ground up and create an installation





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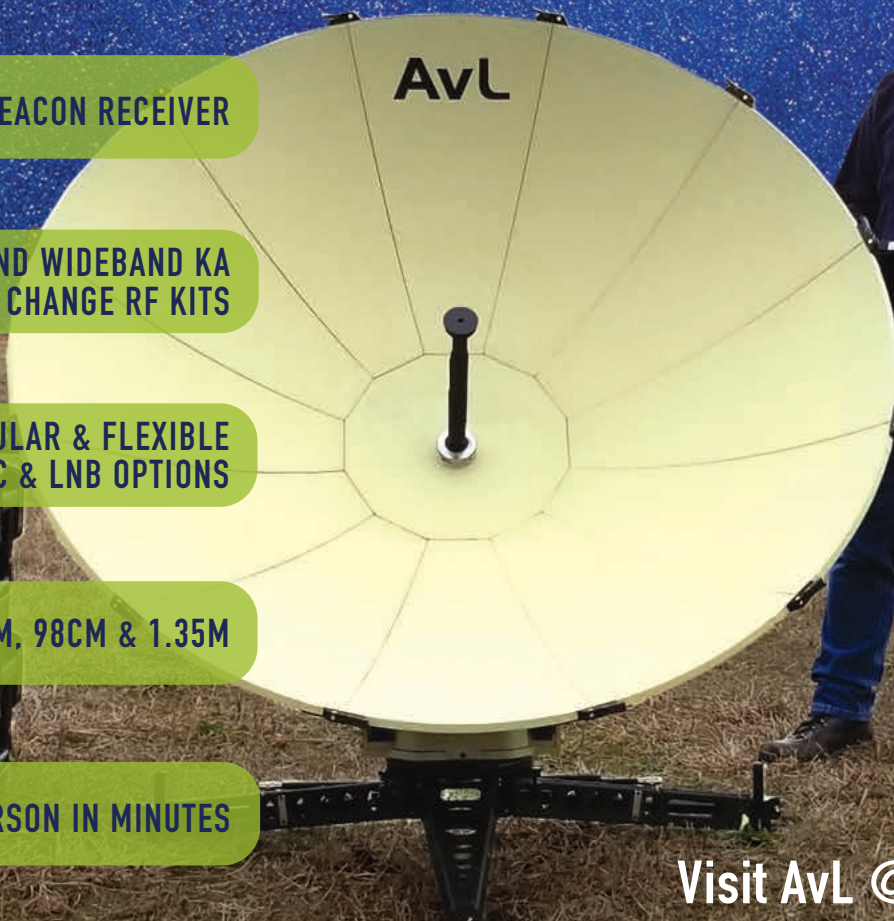
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that will become a universal symbol of innovation and excellence. For this challenge initiative, AFWERX was seeking solutions that will increase the effectiveness of base security and defense.

AFWERX requested proposals to restore and rebuild **Tyndall Air Force Base** into the "Base of the Future" as a model for future base upgrades.

McQ developed a "Global Situation Awareness System" that enables deploying the company's advanced sensors anywhere in the world and immediately connecting the information to distributed users via Iridium's secure satellite network. This system architecture enables multi source fusion, Artificial Intelligence, and Machine Learning via a secure Cloud Based system approach. This eliminates terrestrial infrastructure and provides globally distributed information for "Multi-Domain Operations."



McQ's innovative solution uses the firm's new surveillance products, McQ RANGER® and McQ OWL™. These products and the other McQ technologies are currently providing security at many domestic and foreign Air Force bases with real-time reporting of human activity for Base Security and remote area Situation Awareness missions.

ROCKET LAB'S FAA LAUNCH OPERATOR LICENSE STREAMLINES MULTIPLE MISSIONS FROM LAUNCH COMPLEX 2

Rocket Lab has been granted, a five-year Launch Operator License by the Federal Aviation Administration (FAA) for Electron missions from Rocket Lab Launch Complex 2.

This is a major milestone as the license enables the company to have multiple launches of the Electron launch vehicle from Rocket Lab Launch Complex 2, without the need to obtain individual, launch-specific licenses for every mission. Additionally, it helps to streamline the path to orbit and enable responsive space access from U.S. soil.

Located at the Mid-Atlantic Regional Spaceport within the NASA's Wallops Flight Facility on Wallops Island, Virginia, Launch Complex 2 has been designed to provide responsive launch capability to support U.S. government missions. Between Launch Complex 2 in Virginia and Launch Complex 1 in New Zealand, Rocket Lab can support up to 130 launches each year across a range of orbital inclinations.

The FAA Launch Operator License is a major administrative milestone ahead of upcoming Electron launches including a NASA mission to lunar orbit in support of Artemis, the Agency's program to return humans to the Moon.



Launch complex #2 at Wallops Island, Virginia.

The Cislunar Autonomous Positioning System Technology Operations and Navigation Experiment (CAPSTONE) mission will use Rocket Lab's Electron launch vehicle and Photon satellite platform to deploy to the same unique lunar near rectilinear halo orbit (NRHO) that is planned for NASA's future lunar outpost called Gateway. CAPSTONE intends to validate navigation technologies and verify the dynamics of this halo-shaped orbit to reduce risk for future spacecraft.

Rocket Lab founder and CEO, **Peter Beck**, said, "Having FAA Launch Operator Licenses for missions from both Rocket Lab launch complexes enables us to provide rapid, responsive launch capability for small



satellite operators. With 14 missions already launched from LC-1, Electron is well established as the reliable, flight-proven vehicle of choice for small sat missions spanning national security, science and exploration. With our upcoming missions from Launch Complex 2, we're ushering in an era of even more flexibility and launch availability for these important government missions."

U.S. SPACE COMMAND CELEBRATES 1ST YEAR ANNIVERSARY MILESTONE

In only one year since the activation and stand-up of the Department of Defense's 11th Combatant Command, U.S. Space Command is celebrating the anniversary milestone by focusing on the myriad of mission accomplishments.

USSPACECOM officially stood up during a ceremony in the White House Rose Garden on August 29, 2019, with President **Donald Trump**; Dr. **Mark T. Esper**, Secretary of Defense; Gen. **John W. "Jay" Raymond**, former USSPACECOM commander and current U.S. Space

Force Chief of Space Operations; and Chief Master Sgt. **Roger A. Towberman**, USSPACECOM's former command Senior Enlisted Leader and current USSF CSEL.



U.S. Navy Rear Adm. Michael Bernacchi, left, and U.S. Air Force Staff Sgt. Kiara Kashner, right, representing U.S. Space Command's longest-serving and junior-serving members, respectively, cut a cake in honor of the combatant command's first birthday August 28, 2020, at Peterson Air Force Base, Colorado. Kashner serves as executive assistant to the commandant and Bernacchi is Strategy, Plans and Policy Director.

"We have achieved, with warp-speed-like precision, the stand-up of this newest command," said Gen. **James H. Dickinson**, USSPACECOM commander. *"Only 24 months ago, this concept was a napkin sketch of ideas from a few brilliant warriors, and now we are pulling in Joint Space Warfighters, operating campaign orders, and actively running the protect and defend mission to ensure the continued peaceful use in, from and to space."*

Dickinson assumed command of USSPACECOM from Raymond on August 20 and U.S. Marine Corps Master Gunnery Sgt. Scott H. Stalker assumed responsibility as the USSPACECOM CSEL from Towberman on Aug. 28. Raymond and Towberman transitioned from their dual-hatted assignments to focus solely on their USSF roles.

Persistent and escalating aggression from near-peer and adversarial nations continues to threaten U.S. and Allied space systems. Over the



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past year, USSPACECOM — in coordination with its allies — is working deter conflict, and if necessary, defeat hostile acts and defend vital interests in the space domain.

"In spite of the dangerous actions perpetrated by adversary nations, we're leaning forward to protect and defend the peaceful use of space," Dickinson said. "Campaign orders are being issued and the command is looking toward future efforts that enhance space warfighting capabilities."

A video celebrating U.S. Space Command's work during the past year is available for viewing [at this direct link...](#)

SPACE DEVELOPMENT AGENCY AWARDS TWO TRANSPORT LAYER CONTRACTS FOR SMALLSAT CONSTELLATION



*The **Space Development Agency (SDA)** has awarded two contracts for the first generation of the Transport Layer — these awards represent one of the first major and highly visible steps toward developing the National Defense Space Architecture's inaugural tranche (called Tranche 0).*

This set of contract awards will initiate the design, development, and launch of constellations that will be comprised of tens of satellites with optical intersatellite links capable of sending and receiving wideband data to and from other space vehicles and ground stations.

The capability demonstrated in the Transport Layer Tranche 0 will provide our warfighters with periodic regional access to low-latency data connectivity via space-based extensions of existing tactical data links.



***York Space Systems** was awarded a \$94,036,666 firm-fixed-price contract for the Space Development Agency Transport Layer Tranche 0. The work to be performed under this contract will include on-time delivery of space vehicles (SVs) and paths to optical intersatellite link (OISL) interoperability success.*



***Lockheed Martin Corporation** is awarded a \$187,542,461 firm-fixed-price contract for the Space Development Agency Transport Layer Tranche 0. The work to be performed under this contract will include on-time delivery of space vehicles (SVs) and paths to optical intersatellite link (OISL) interoperability success.*

BALL AEROSPACE IS PRIMED FOR USSF'S GC3 SYSTEM

***Ball Aerospace**, teamed with **Booz Allen Hamilton**, was awarded a contract by the **Space Rapid Capabilities Office (SpRCO)** to serve as the prime system integrator for the SpRCO Ground Command, Control and Communications (GC3) system — GC3 will integrate into and help enable the larger tactical command and control enterprise for the United States Space Force.*



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The program will develop and deliver updated and enhanced satellite operations capabilities that enable continuous modernization by maximizing automation, flexibility and commonality. Key to the system's flexibility will be the use of Hexicon, a modular, open and scalable event driven software architecture that allows for rapid and seamless integration of new software and overall increased system resiliency.

Ball draws upon two decades of ground systems integration and support, including command and control operations, for critical civil and national defense programs, such as NASA's Kepler mission to discover exoplanets and U.S. Air Force's Space-Based Space Surveillance program to detect and track space objects and spacecraft. With Hexicon at its heart, SpRCO's GC3 system will represent the next step forward in scalable and future-proof operations.

Executive Comments

"The GC3 System Integrator program provides a great foundation to work with SpRCO and other space resiliency mission partners to develop and deliver advanced capabilities to support the warfighter," said Mark Healy, VP and GM, National Defense, Ball Aerospace. "This mission aligns directly with the 2020 Defense Space Strategy to enable the Department of Defense (DoD) to defend the space domain."



"We look forward to working closely with SpRCO in developing a multi-mission ground system," said Steve Smith, VP and GM, Systems Engineering Solutions, Ball Aerospace. "We are extremely excited to unleash the full potential of Hexicon, our ground-breaking event driven architecture developed for other advanced national defense programs and apply it to meet the Space Force's global operations."

"We look forward to supporting Ball Aerospace and the SpRCO and continuing to advance and defend our nation's space superiority," said Michael Johnston, VP, Booz Allen. "Booz Allen's deep expertise shaping open-source solutions and securely integrating cloud services for ground systems



engineering will help support this critical mission and keep cybersecurity at the forefront in the development and implementation of GC3."

USSF'S SMC VERIFIES WGS MITIGATION + ANTI-JAM ENHANCEMENTS



The United States Space Force's Space and Missile Systems Center completed the First Article Test (FAT) Increment 3 of the Mitigation and Anti-Jam Enhancement (MAJE) capability for the Wideband Global SATCOM (WGS) program, June 18.

Adaptive Nulling and Detection capabilities were successfully tested during the FAT with the test resulting in passing 165 requirements. The adaptive nulling test demonstrated MAJE's ability to suppress interference to optimize performance when contested. Detection testing measured MAJE's ability to detect simulated interferers based on power level and frequency.

This significant achievement marks the first increment of FAT testing performed for the WGS program under Space Force. These capabilities will further the mission to bring full-time operations dedicated to defending our vital national interests in space.

MAJE consists of software and hardware upgrades for the Army-operated Global SATCOM Configuration Control Element (GSCCE) ground system that performs detection, identification, geolocation and mitigation of unwanted Radio Frequency energy on the WGS 1-10 satellites.

Due to limitations posed by the COVID-19 global pandemic, 10 days of testing were completed virtually with operators and witnesses teleworking. Army and USSF personnel witnessed test procedure execution while the equipment under test was physically located at Boeing's Mission Operations Support Center in Colorado Springs, Colorado.

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SATELLITE INNOVATION 6-8 October

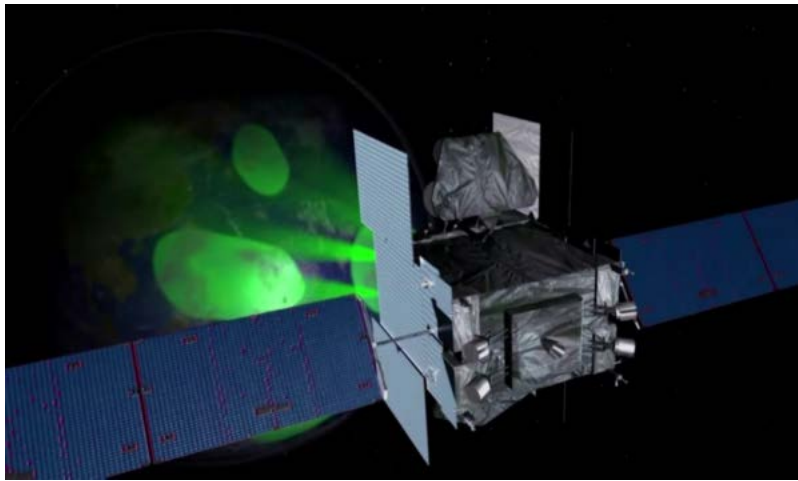
Capt. **Connor Macmillan**, WGS Test & Integration lead from SMC's Geosynchronous/Polar Orbit Division; and **Nasir Muhammad**, MAJE Lead from the Aerospace Corporation oversaw the test's execution.

Upon MAJE fielding to warfighter operations, WGS 1-10 will have an inherent geolocation and interference mitigation capability allowing for quick isolation of unwanted signals and faster restoral times of affected authorized user communications.

FAT-4, scheduled for this fall, will test the MAJE system's Geolocation ability. FAT-5, the final increment of FAT testing, will complete Multi-capability and end to end testing. Successful completion of all FAT increments will establish that the GSCCE-MAJE system is ready to move forward into the interface verification with the Army's subsystems.

"MAJE will double the anti-jam SATCOM capabilities for six Geographic Combatant Commands," said Col. **John Dukes**, SMC's Geosynchronous Polar Orbit Division senior materiel leader.

WGS satellites are the backbone of the U.S. military's global satellite communications. WGS provides flexible, high-capacity communications for the Nation's warfighters by providing worldwide, high data rate and long-haul communication for marines, soldiers, sailors, airmen, the White House Communication Agency, the US State Department, international partners and other special users.



ENVISTACOM NAMED A BEST FOR VETS EMPLOYER



The competition was stiff and a total of 164 organizations submitted responses to the *Military Times* Best for Vets: Employers Survey that ran from March to July 2020. *Military Times* announced its 2020 Best for Vets: Employers ranking which includes **Envistacom, LLC**. The

survey is an analysis of a company's efforts to connect with veterans and provide an environment for their success.

"We're thrilled to be included in the 2020 Best for Vets: Employers ranking as it reflects our commitment to providing opportunities for America's veterans," said **Alan Carson**, President at Envistacom.

"Veterans' military experience equips them with unmatched skills in leadership, critical thinking, and advanced technologies providing a unique value to employers."

The criteria for evaluating the companies is based on years of Military Times research, interviews with veterans, and input from veterans' advocates and human resources professionals. The survey was written, analyzed, weighted and scored in partnership with data analysts at the Veterans Research Network, which was part of ScoutComms but is now part of the Fors Marsh Group.

The rankings can be found here: bestforvets2020.militarytimes.com

"Best for Vets is editorially independent and focused on culture and policies that cater to military veterans," said **Andrew Tilghman**, Executive Editor at *Military Times*. "It has become the most trusted resource for transitioning veterans and a coveted honor for employers across the country."

In its 11th year, the Best for Vets: Employers rankings were based on a voluntary survey that included more than 100 questions seeking detailed information on the company's policies and practices related to veteran recruitment and retention, support for translation of military skills to civilian credentials, support for military spouse employment and support for members of the National Guard and Reserves.

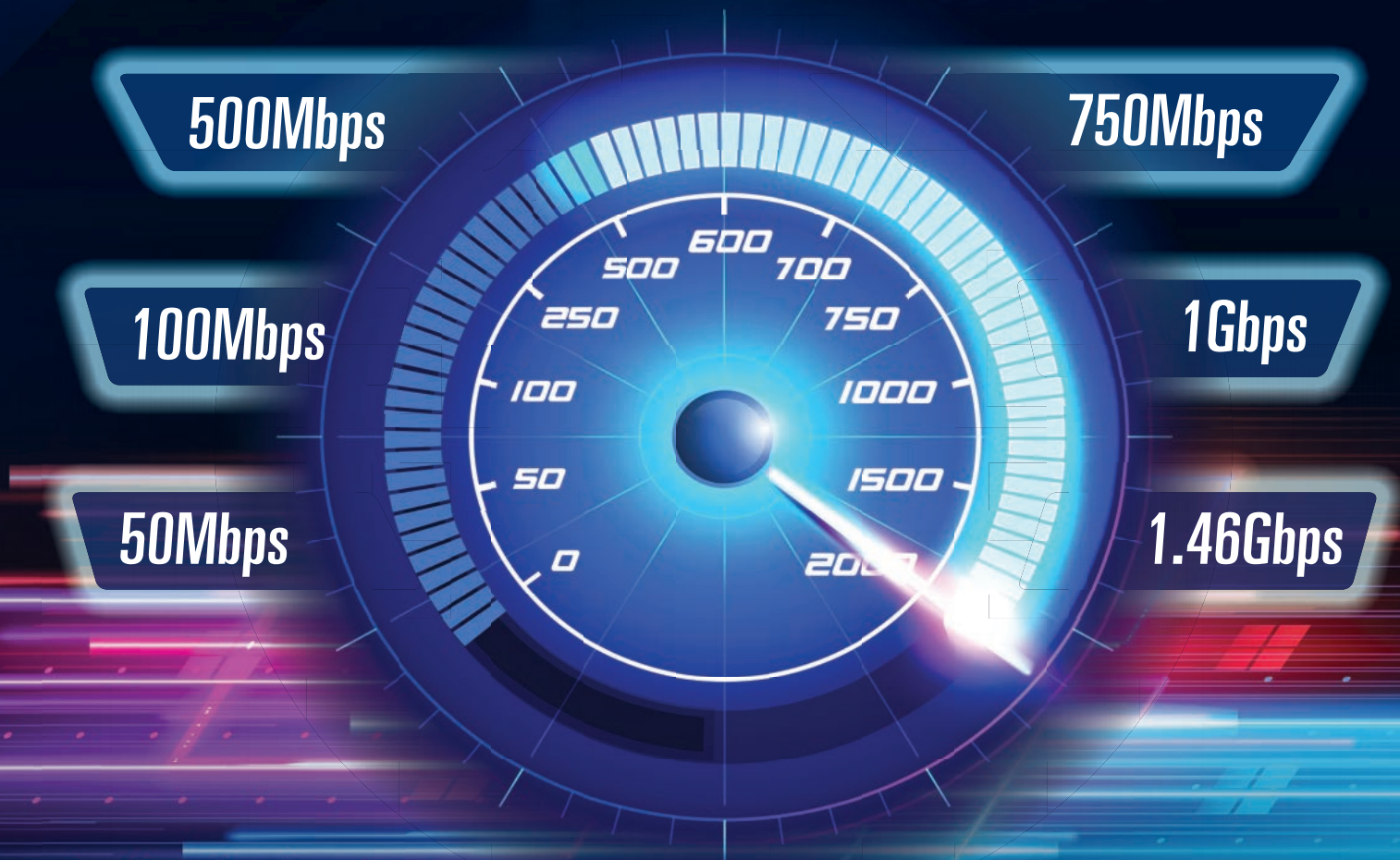
Envistacom provides communications, cyber and intelligence operations solutions to the U.S. DoD and coalition partners in the aerospace, defense, and intelligence communities. Customers rely on Envistacom for rapid-response, secure technology solutions and subject-matter expertise to support mission critical operations.

With a team of former military leaders and domain experts located around the world, and multiple indefinite delivery, indefinite quantity (IDIQ) contract vehicles worth over \$62 billion, Envistacom is a trusted partner in protecting military, civilians and critical infrastructure around the world. Envistacom is a Disadvantaged Woman Owned Small Business (DWOSB)





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GLOBAL SPACE PARTNERSHIPS BEGIN @ SPACE AND MISSILE SYSTEMS CENTER (SMC)

The Chief Partnership Office (CPO) within the Space and Missile Systems Center's Portfolio Architect is in the business of innovative acquisition: Transforming the future of space with new ways of collaborating on technology, and forming competitive strategies to defend our nation and allies.

The CPO was conceptualized by SMC Commander and Program Executive Officer for Space, Lieutenant General **John F. Thompson** as the one stop shop for allies and potential partners across the commercial and interagency sectors who are interested in collaborative opportunities and global space cooperation with the U.S. Space Force.

"As part of the U.S. Space Force, SMC is aligned with the National Defense Strategy and strengthening alliances and seeking new partnerships makes us stronger," General Thompson said. "Space is a team effort and working with our allies, interagency, industry and academia is vital to protecting the global commons of space."



At the core of SMC's international objective is a clearly laid out mission: To continue to deepen, expand, grow, and develop allied partnerships and engagements in every part of the space architecture to make it more robust and more resilient.



Sir Stephen Lovegrove, UK Permanent Secretary to the Minister of Defense, and his delegation receive Space and Missile Systems Center briefing during a tour of the Los Angeles Air Force base, El Segundo, California. U.S. Air Force Photos / Van De Ha.

Offensive and defensive space domain strategies support that effort. The offensive strategy ensures the U.S. stays ahead of the game; removing silos and exploring opportunities to align with the best technological partners to integrate the best technological capabilities. SMC's defensive strategy makes sure the U.S. identifies and forms the correct partnerships with allies to align against competing adversaries; and to circumvent adversary alliances.

SMC's international objective includes continuously seeking, identifying and engaging partners while being aware of all the interagency and commercial threads available. Everything done by the Chief Partnership Office is evaluated through space enterprise architecture and its alliances with allies, and commercial and civil partners. The CPO aims to bring in new, non-traditional commercial partners with new capabilities and highlight opportunities that can be integrated into that space architecture.

"We've identified many partnership opportunities from payload hosting, to co-developing major space systems, or sharing infrastructure, data, and ground assets. These are significant areas where we can deliver better and faster [capabilities] through global partnership," said **Deanna Ryals**, the Chief Partnership Officer at SMC.



One such example is when the SMC Production Corps' Enhanced Polar System (EPS-R) program had a requirement for payloads to fill a vital gap in providing secure communications for warfighters in the Arctic region. Through discussions with the Norwegian Ministry of Defense and Space Norway, SMC's CPO identified a beneficial hosting opportunity. Both EPS-R payloads will be hosted on Norway's satellites, saving a billion dollars.



Lt. Gen. John F. Thompson, commander of the Space and Missile Systems Center (SMC) and Air Force program executive officer, meets with Lt. Gen. Klaus Habersetzer, Executive Director of the Joint Air Power Competence Center, during a tour by Germany Military Delegation at the Los Angeles Air Force base, El Segundo, California. U.S. Air Force Photo by Van De Ha.



German Military Delegation led by Lt. Gen. Klaus Habersetzer, Executive Director of the Joint Air Power Competence Centre, receives mission briefings at the Space and Missile Systems Center, Los Angeles Air Force base, El Segundo, California.

This partnership will also allow SMC to deliver capability to warfighters three years sooner than initially planned. The satellites are slated to launch in 2022 on a SpaceX Falcon 9 rocket and will deliver a great advantage for warfighters in that region.

Ryals explained, "When we go into a contested environment, we're not going in alone. We go in with our partners, with our aligned war-winning capabilities."

Growth and Transformation

These past few months, the global pandemic hasn't slowed international partnerships nor acquisitions. In fact, it has just offered the CPO more opportunities to be innovative.

"Even in a time of great crisis, we continue to work together," said Ryals. The CPO has continued to expand networks and extend the reach of Space partnerships. Three prominent areas are laid out and ready:

- **Continuing partnerships in satellite communication:** CPO works to bring together sovereign and allied capabilities to enhance communications networks.
- **Space domain awareness:** Technologies such as sensors, ground capabilities, deep space radars, situational data sharing and distributive ground architectures will be continuously formulated through partnerships.
- **Space Command and Control (Space C2):** Together, with allied partners, the CPO is working to build war-winning and innovative software in an agile environment to give combatant commanders common operating views of the space battlefield.

"U.S. Space Force, U.S. Air Force and SMC's Chief Partnership Office are looking at how we intend to do security cooperation overall moving forward," Ryals noted. "We're looking at how to be innovative, go faster, leverage new tools and even explore opportunities for new legislation if necessary."

Looking to the Future

By leveraging innovation, tapping into new global markets, and strengthening current and building new alliances, SMC is bringing new tools to the Space Enterprise Architecture.

Through events such as **International Space Pitch Day** with the U.K. MoD and Allied Accelerators with Norway and the Netherlands, SMC is synthesizing the very best and newest U.S. and allied space capability development.

Angela Lindemuth, SMC's Chief, Europe Space Partnerships finds it exciting to be able to be a part of the initiative to build up the international effort from the ground up.

She said, "Relationship-building at every level extends across our team and across the global markets where we operate and partner today, and where we see opportunity to align in the future. We all share a similar passion."

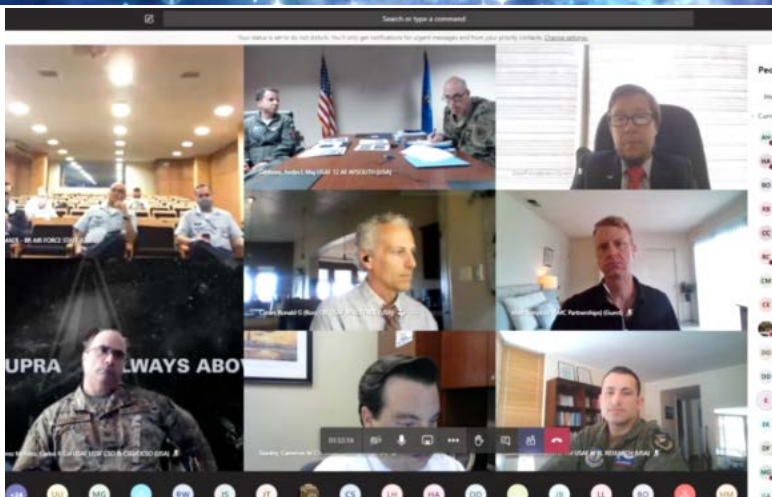


Lieutenant Colonel Jim Tobin, SMC's Chief of Americas, Space Partnerships, echoes the sentiment and finds the CPO to be challenging and exactly the correct fit for his interests. "We're building common agile operating environments where capabilities can be deployed at all locations as needed."

As SMC's international arm continues to transition and build, the team looks forward to gaining a more robust and dedicated function within the Space Force as its development continues.

"I love my job," said Ryals. "I'm excited every day about getting up and going to build coalition capabilities with allies. This is the truly the most exciting and rewarding job in the world."

Contact SMC: SMC@us.af.mil



ENGAGED IN SOUTH AMERICA

In August, the Space and Missile Systems Center and the U.S. Space Force joined with the Brazilian Air Force, for the first-ever U.S.-Brazil Space Engagement Talks.

Designed as a forum to advance U.S. and Brazilian space operations objectives in capability development, the talks were the first-ever senior space flag officer event between the two countries, as well as the first such event for the U.S. Space Force. Due to the global pandemic, the talks were held virtually, and aimed to strengthen the existing space partnership between the two nations

INNOVATORS, BRING YOUR "I" GAME

U.S. Space Force, Space and Missile Systems Center and United Kingdom Ministry of Defence Partner for First-Ever International Space Pitch Day

Non-traditional defense businesses and innovators from all over the world and from across all areas of space capability are competing for the opportunity to pitch to senior military decision-makers as part of the first International Space Pitch Day.

Those selected to participate in the two-day event, Nov. 16-17, will make their pitch from a coveted stage in front of senior United States, United Kingdom, and NATO military leaders at the UK Defence Space Conference in London. Due to global pandemic restrictions, the event may be held virtually.

Contracts totaling \$1M will be awarded to fund up to 15 proposals, each with a maximum value of approximately \$67K. Each funded project is expected to be completed and delivered within three months.

Led by the UK Defense and Security Accelerator and the UK Defence Science and Technology Laboratory Space Program, on behalf of the UK Ministry of Defence (MOD) and the US Department of Defense (DoD), International Space Pitch Day is a new approach to accelerate the development of commercial space technology and rapidly provide solutions to identified defense problems.

The competition kicked off in July of this year, with a series of webinars inviting interested commercial businesses, entrepreneurs and more to learn about the event and ask questions in an open forum about how to prepare and submit a proposal.

The event is designed to help lower the barrier of entry for those in the commercial sector to partner with government

as well as identify opportunities for cooperation between the U.S. military and the Brazilian government.

Additional participants included the Brazilian Ministry of Defense, the Brazilian Space Agency, the U.S. Embassy in Brazil, U.S. Southern Command, U.S. Space Command, the Office of the Deputy Assistant Secretary of Defense for Space Policy, the Office of the Deputy Assistant Secretary of Defense for Western Hemisphere Affairs, Air Forces Southern, and the Air Force Research Lab. Discussions focused on future collaboration opportunities in space situational awareness, research, development, test, and evaluation, launch, and satellite command and control.

"As our best and brightest partners continue to become space-faring nations, we are striving for allied partnership in every part of space architecture," said Lt. Col. Jim Tobin. "The Space Force is driving that collaborative approach and we are supporting that collaborative vision every step of the way."

The United States' space partnership with Brazil, Latin America's leader in space operations, and other regional partners, helps ensure access and the use of space for responsible and safe purposes. The U.S.-Brazil space operations strengthen U.S. and allied competitive advantage by improving mission assurance and military effectiveness across all domains.

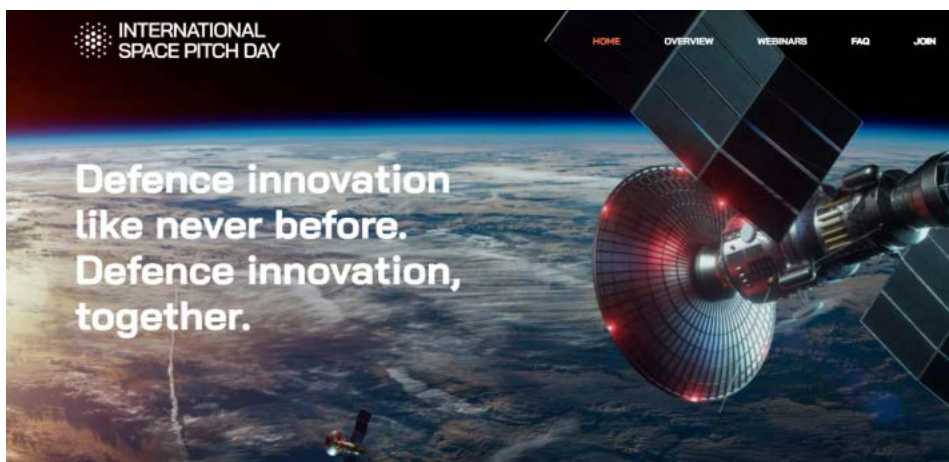
space organizations. Through the competition, the U.S. Space Force, SMC and the UK MOD are aligned as early adopters of emerging technology to deliver war-winning capabilities discovered from the world's most innovative entrepreneurs.

"We must keep pace with the rapid technological capabilities being developed in the commercial sector all across the world," said Angela Lindemuth, SMC's Chief, Europe Space Partnerships. "International Space Pitch Day is focused on discovering technologies with proven commercial value, which can be applied to expand military space capability."

In October, event organizers will announce their selections for who will deliver their in-person or virtual pitch. To help participants prepare for their big break, a five-week Allied Defense Accelerator course featuring specialized business mentoring was offered to those selected to pitch at the event.

To learn more about International Space Pitch Day, visit

intlspacepitchday.com





NEXT-GENERATION, FLAT PANEL INTEGRATION

By Karl Fuchs, iDirectGov Senior Vice President of Technology and MilsatMagazine Senior Contributor

Antennas are useless until coupled with the appropriate radio frequency (RF) equipment, such as a modem, block up converter (BUC), low noise block (LNB), etcetera.

Naturally, baseband equipment is a requirement. Of course, all these components need power, and a way to easily point the antenna is required.

Bringing all these disparate components together to provide the end-user with an integrated, practical, rugged and easy-to-use package has been the purview of systems integrators. Virtually all modem, antenna and radio frequency terminal manufacturers have extremely close working relationships with their integrator partners. For decades, these vendors have formed a symbiotic ecosystem which is a crucial part of the satellite industry.

The job of the systems integrator is not an easy one. Although designing and ordering custom-made components is often a possibility, quite frequently, the integrator must use off-the-shelf components and work within the physical and operational parameters of the modules.

The unique characteristics of the components greatly reduce the flexibility the integrator has to minimize the size, weight and power (SWaP) of the terminal. These problems are greatly magnified when integrating with flat panel, electronically steerable antennas (ESAs).

One highly valued characteristic of ESAs are their inherent SWaP. If the supporting components in the integrated terminal are not designed specifically to integrate with flat panel antennas, the SWaP attributes of the solution will be greatly undermined.

Another growing trend affecting flat panel integration in the satellite industry is the proliferation of waveforms and end-user needs for them to support. The simplest solution to supporting multiple waveforms is to utilize multiple modems. Employing multiple modems is hardly an elegant solution, and of course, is not conducive to SWaP.

The proliferation of waveforms is driven by a number of factors but fundamentally based on enhancements of satellite technologies. The move from bent pipe, geosynchronous satellites to High Throughput Satellite (HTS) architectures drove an upsurge of new waveforms. The birth of Low Earth Orbit (LEO) and Medium Earth Orbit (MEO) is driving another.

One argument regarding the genesis of such a plethora of waveforms is the lack of accepted industry standards and satellite modem vendors protecting their own proprietary RF signals. Although there is some truth to the argument, emerging satellite technologies do necessitate changes to waveforms.

To meet the needs of the satellite end-user, both the convenience and SWaP of flat panel antennas and multiple waveforms in a single, compact modem are required. The preeminent solution to the multi-waveform problem is the development of a Software Defined Radio (SDR).

SDRs have been in the market for a number of years, however, not all SDRs can accommodate all waveforms. With a thorough understanding of hardware and firmware design of a modem, one realizes there are underlying system elements which are waveform dependent.

For example, automatic gain control (AGC) algorithms can be vastly different on single channel per carrier (SCPC) modems compared to AGCs on time division multiple access (TDMA) modems. The waveform timing mechanism often determines which clocks within the hardware are free running versus slaved.

The tradeoff between the physical dimensions of the analog portion of the SDR modem versus the range of modulation orders supported must be carefully considered. All of these challenges can be overcome; however, it does lead to the integration work of a waveform on an SDR modem to be more complex than is often imagined.

The key to success in designing components for the next-generation flat panel antennas is flexibility. Various flat panel antenna manufacturers will have different architectures for their integrated antenna control units (ACUs) and other components essential to the antenna design.

To meet the SWaP requirements, flat panel antenna manufacturers and terminal integrators cannot be plagued by problems such as cable bend radius to realize a design. Therefore, the outmoded paradigm of simply integrating off-the-shelf components where the IF, Ethernet, power and other interfaces are predetermined will no longer suffice. It is imperative a new physical architecture for modems be adopted. This means incorporating an architecture which allows for freedom of design.

Such an architecture would mean that the analog section and the digital section of the modem are no longer rigidly coupled, but rather they use standardized interfaces and have internal loopback self-checks. This allows an antenna manufacturer or an integrator to design their own carrier board complete with all the components necessary to deliver a comprehensive solution.

By decoupling the analog and digital portions of an SDR and allowing flat panel antenna manufacturers and integrators the flexibility to directly integrate the components on the control board instead of using IFL and Ethernet cable, the promise of a truly integrated system can be achieved.

In addition, this approach serves as a bridge to the next steppingstone in terminal design, which is the migration toward digital IF. With digital IF, the interface to the SDR is no longer L-band, but, rather digitized RF known as in-phase quadrature, more commonly referred to as I/Q.

The revolution in antenna design — which is being driven by radical changes in satellite technologies and multi-orbit topologies — is, likewise, driving a revolution in modem and RF transmission equipment. It is vital to the satellite industry that the manufacturers of all components — whether antenna, SDR or transmission — be in lockstep as technology marches on to ensure the best solutions reach the end-users.

www.idirectgov.com

Karl Fuchs is the Senior Vice President of Technology at iDirectGov, a U.S. corporation that is a trusted partner of the U.S. government and has been for more than 17 years. Fuchs has more than 20 years of experience in the areas of technology and the federal government and is a Senior Contributor to MilsatMagazine.



Fuchs leads iDirectGov's team of federal systems engineers and serves as chief architect for new product integration and specialized technology, including transmission security (TRANSEC), Communication Signal Interference Removal (CSIR™) and Open Antenna Modem Interface Protocol (OpenAMIP).

All Defense-grade products sold by iDirect Government are designed, developed, assembled, programmed and verified within the United States. All of the company's employees are U.S. citizens, with a third being U.S. military veterans and more than 60 percent holding U.S security clearances.

Contact Karl Fuchs at kfuchs@idirectgov.com

FUEL FOR THE FUTURE OF EARTH INTELLIGENCE

By Kevin Lausten, Senior Director,
Technology & Market Accelerator, Maxar Technologies

Maxar is a leading provider of information about our changing planet; however, that information has been limited to a 2D representation from satellite imagery.

With the addition of Vricon's unique 3D capabilities, Maxar will unlock a new dimension of information that will enhance the utility of the company's imagery for customers, as well as meet the requirements of future technology and machine learning applications.

Now that Vricon's products will be connected to Maxar's entire 110-petabyte imagery archive, there will be faster, scalable production with global availability. With WorldView Legion, the imagery refresh rate and subsequent derived 3D models will allow customers to truly keep up with our changing planet at an unprecedented speed in the industry.

Information derived from the third dimension is similar to the depth of information gleaned from skimming an outline versus an in-depth read of a publication. Let's take, for example, the following evolution of mapping information as a roadmap as to how each new layer of information significantly improves the utility of the map.

A basic 2D map is shown in **Figure 1** to the upper right, which is great for positional location and relative distance from one feature to another:

If we add terrain shading and contours to the map, as shown in **Figure 2**, we now get a basic understanding of topography:

Electro-optical imagery allows identification of the features on the map, so the characteristics of the buildings and the surroundings now are recognizable and distinguishable, as shown in **Figure 3**:

Finally, with 3D data, the map now comes to life providing a bird's eye view where all features are recognizable, and the dramatic changes of the topography are plainly apparent (**Figure 4**).



Figure 1.



Figure 2.

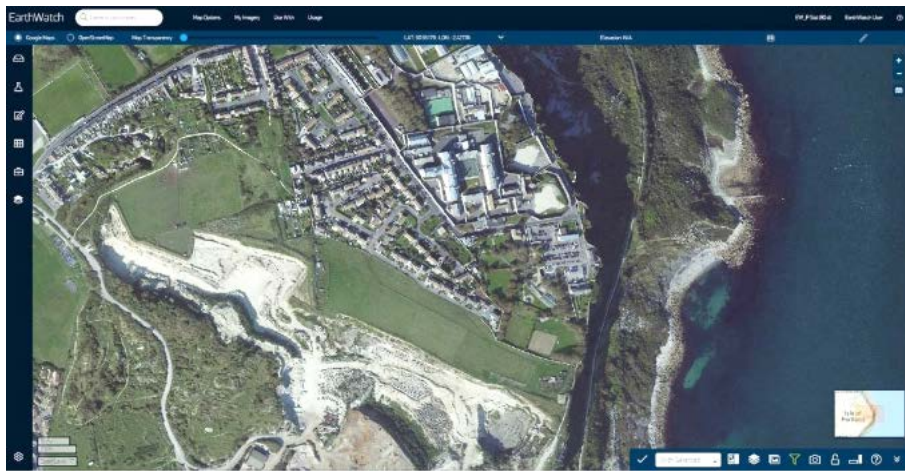


Figure 3.



Figure 4.

However, Vricon's technology goes beyond enhancing our mapping capability. The derivatives created from the Vricon 3D Surface Model such as Digital Surface Model (DSM), Digital Terrain Model (DTM), and 3D Vectors are critical to the advancement of emerging technologies such as 5G signal propagation, autonomous vehicles, smart cities and internet of things (IoT), as well as guided munitions and disaster response planning and mitigation.

3D Mapping

3D maps have become a foundational source of information for a range of visual and analytical applications. However, traditional sources of 3D information have been ineffective due to their limits in geographic scale, accuracy and currency.

Customers need precise 3D information to understand where and how to deploy resources.

For example, with the growth of 5G telecommunications, network planners and operators use propagation modeling software that needs exact information about urban, suburban and rural environments to deploy infrastructure in an effective and efficient manner. Civil and local governments use hydrological and simulation modeling software that requires highly accurate 3D models to assure proper emergency planning and response efforts.

Derivative datasets from the core Vricon 3D Surface Model enable infrastructure and resource planning activities in a more timely and cost-effective fashion than existing, manually produced methods.

Military Simulation + Virtual Training

Faced with sophisticated adversaries, today's warfighter requires familiarity with an area before deployment.

Training, planning and rehearsal demand realistic 3D situational awareness—as well as the ability to georegister disparate information sources. Visualization is critical to success, yet traditional approaches are limited in scale and/or quality.

Vricon's accurate and realistic 3D representation of global battlefield environments enable life-like flight simulations and precise environments to train and simulate mobility and tactical planning.

As proof of the importance of a synthetic training environment to the modern military, the U.S. Army awarded Vricon a \$95 million contract for One World Terrain in 2019.

Precision-Guided Munitions

The current workflow for the extraction of precision coordinates is time consuming and inefficient. Vricon's 3D technology will drive tremendous efficiency improvements to the mensuration process by enabling users to extract x, y and z coordinates in a fast and reliable manner.

An Accurate Foundational Layer for all EO Data

With the proliferation of geospatial data and new sensors constantly expanding, there has never been a more pressing need for a common alignment layer for all Earth Observation (EO) data. Having a highly accurate foundational layer will enable customers to fully leverage the information captured within these images as well as the effectiveness of artificial intelligence (AI) to produce consistent results.

Leveraging the technology behind Vricon's Precision 3D Registration (P3DR), Maxar will be able to positionally correct all 2D images to become the geospatial reference standard for existing and next-generation location-based applications, accelerating the creation of a living, digital model of the Earth.

Learn more about the full Vricon 3D product portfolio
[**via this direct infolink...**](#)

[**www.maxar.com**](http://www.maxar.com)



Image credit—Maxar Technologies.



The VIIRS sensor for JPSS-2 comes out of thermal vacuum chamber testing at Raytheon Intelligence & Space.
(Reuben Wu/Raytheon Intelligence & Space)

FROM PHOTONS TO FORECASTS

By Shawn Cochran, Senior Manager, Civil & Environmental Space & C2 product lines, Raytheon Intelligence & Space

Weather prediction has been a part of mankind's existence for centuries.

From mariners trying to figure out the state of the sea to farmers using the *Farmer's Almanac* for a long-range weather outlook to plan out better crop yields. These early forecasters were attempting to predict the weather based on the past — however, what about the future of forecasting?

Today's weather forecasting is a quantum leap from those days. Nothing has disrupted and improved forecasting more than the advent of highly accurate weather satellites.

Satellites have greatly improved our understanding of the planet and weather phenomena, allowing us to peer, quite literally, inside the eye of the storm.

Satellites also help forecasters make more accurate predictions, allowing people know if it will be a hot day or if they need to prepare for an approaching hurricane.

All of the weather information we access on our smartphones or local news stations comes from a network that starts in space. From satellites to ground antennas, sensors, data processing and more, these networks ensure that weather data is delivered to users in a quick and timely manner.

One of these weather forecasting networks starts with Raytheon Intelligence & Space's VIIRS (*Visible Infrared Imaging Radiometer Suite*).

VIIRS is aboard Suomi National Polar-orbiting Partnership and NOAA-20, the next-generation satellite for the Joint Polar Satellite System, or JPSS.



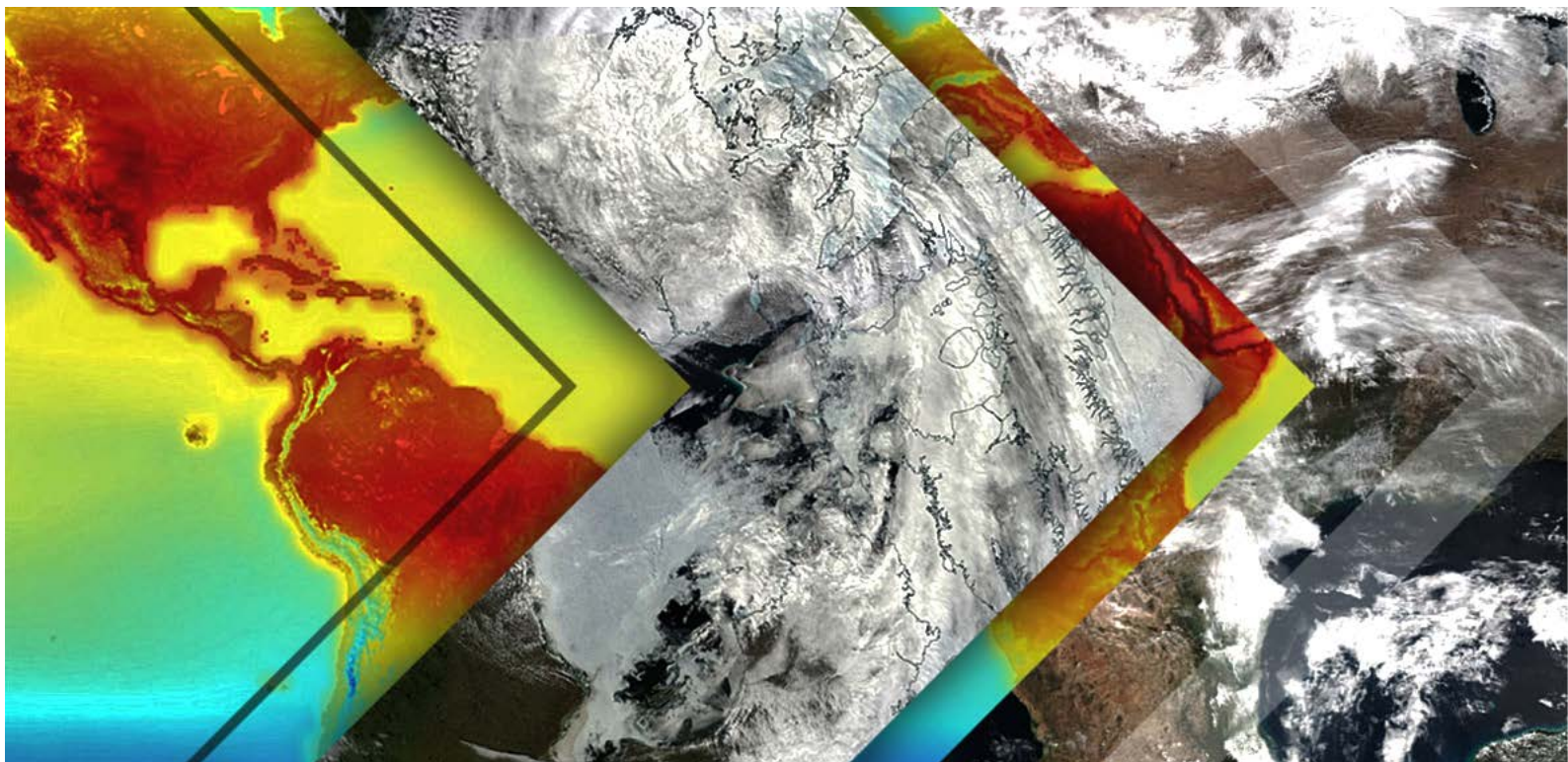
NASA's unprecedented Earth at Night images rely on the extraordinary low-light sensitivity of the VIIRS day-night band.

As the satellites circle the Earth from pole to pole, VIIRS captures photons — light from the planet — through a sensor, similar to how cameras capture light to produce images.

VIIRS has also made an impact when it comes to monitoring tropical cyclones and hurricanes. As storms intensify more rapidly and move more slowly, forecasters are now able to predict the arrival of storms

five to seven days out, instead of only three days as in the past. That gives first responders and residents four additional days of awareness to understand whether storms will impact their area.

There are other instruments and satellites collecting weather and environmental data, including the Moderate Resolution Imaging Spectroradiometer, or MODIS, another RI&S instrument. MODIS,





NOAA-20, designated JPSS-1 prior to launch November 18, 2017, was the first of the polar-orbiting Joint Polar Satellite System.

aboard Aqua and Terra satellites, continues to provide valuable research data 20 years after launch.

Data captured by VIIRS and other instruments is downlinked to the ground via the [*JPSS Common Ground System*](#).

Designed by RI&S for the National Oceanic and Atmospheric Administration (NOAA) and NASA, JPSS CGS downloads the data from more than seven polar-orbiting satellites built by agencies in the U.S., Europe and Japan. The raw data is then processed into environmental data records, or EDRs, and sent to locations around the world.

In the U.S., EDRs are ingested into key U.S. centers, where complex hardware and software systems process the data, enter it into a database and visualize it for users such as NOAA's National Weather Service, or NWS, the U.S. Air Force and the U.S. Navy.

The entire process, from the moment that photons hit the spacecraft to the time that weather products are available to customers, takes less than an hour on average with NOAA-20.

Using a tool called the Advanced Weather Interactive Processing System, or AWIPS, NWS and NOAA can ingest, process and distribute data to weather forecast offices around the country. AWIPS is also the weather data endpoint where forecasters visualize the data together in one screen to produce local forecasts.

It's not just severe weather events where up-to-the minute information matters. The U.S. Air Force Space and Missile Systems Center (SMC) is working to develop their next-generation weather satellite to improve the weather data that operators use to plan missions.

RI&S will provide an initial prototype design, enabling theater weather imaging and cloud characterization capabilities. Understanding clouds and cloud movement is used for things as simple as route planning for air-to-air refueling or to know where clouds might be covering an area of interest.

It can be easy to forget about the satellites that bring us our daily weather data. But programs like JPSS have broad impacts across the U.S., which can be seen in the new website.

In addition to weather data, the JPSS program can track air quality impacted by forest fires and can monitor the health of the oceans. It also supports communities around the country in partnerships with state and local governments, industry and academia.

The next time you receive a weather alert on your smartphone or smartwatch, or your local meteorologist delivers the weekly forecast, think about the weather satellites 500 miles up in space, collecting data about the Earth's weather.

RI&S is building on that initial paradigm shift with more VIIRS instruments and weather satellites planned for launch in the coming years. With new technologies such as AI and machine learning, forecasters will be able to sift quickly through the massive trove of data coming in every second to make better, faster predictions.

[**www.raytheonintelligenceandspace.com**](http://www.raytheonintelligenceandspace.com)

Mr. Shawn Cochran is senior manager for Civil and Environmental Space in the Space & C2 Systems product line at Raytheon Intelligence & Space. He supports programs such as the Visible Imaging Infrared System for the NASA/NOAA Joint Polar Satellite System. Prior to joining S&C2 Systems, Mr. Cochran was the chief scientist for the Joint Polar Satellite System Common Ground System and the head of the Mission Data Services program. Previously, Mr. Cochran was the head of Systems Engineering / Operations for the United States Missile Defense Agency's Integration and Operations Center at Schriever AFB, Colorado. His career focus has been large scale systems-of-systems integration and command and control systems. He has been with Raytheon Intelligence & Space since 2004.





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THE 'CYBER-RANGE' ADVANTAGE FOR DEFENCE

By Mark Roberts, Defence and Security Lead, RHEA Group

Society globally is becoming increasingly dependent on space products and services, both for business and in our personal lives. Anything that involves accurate timing and positioning almost certainly depends on satellites.

Without these space-enabled services, many things we take for granted, such as utilities, transportation, banking and communications, would either be lost or, at best, provided at lower quality and might be unreliable. The consequences would be serious.

Defence is clearly not immune from these issues. In fact, arguably, its reliance on space is even more pervasive than that of society generally. Whether it be inter- or intra-theater communications, weapons guidance, signals or image intelligence, or simply moving around air, land and sea battlespaces, defence relies very heavily on space.

For these reasons, it is essential that we understand the threats, vulnerabilities and risks associated with loss of space products. It is also vital that we find ways to mitigate them. Thanks to the interdependence of space and security, there is a solution in the form of a cyber-range, which builds on space and cyber attributes to provide ways to protect against cyber threats and mitigate cyberattacks.

Offensive or Defensive?

The boundaries between space and cyber are blurring, seemingly particularly benefitting those who seek to do harm. The distinction between military and non-military is no longer as clear as it once was, as dual-use technologies and capabilities in the space domain make it less clear who is using what, when and for what purpose.

Similarly, in the cyber domain, the line between 'offensive' and 'defensive' actions is no longer always clear, especially as offensive activities are being justified as defensive, thus shifting the norms of acceptable behavior toward the 'offensive' end of the spectrum. It does not help that in space and cyber, the cost of attacking is comparatively low compared with the high cost of defence.

As a result, highly developed countries can be vulnerable to attack from less developed ones, as well as from terrorist groups and other actors. Unlike other areas of society, defence does not have the luxury of waiting for international norms of behavior to be agreed — if, indeed, that is even possible. As history repeatedly shows us, the next conflict may be just around the corner and could be very different from the last. There is, therefore, a need for a clear understanding of how military operations can be waged successfully in the contested environments of both space and cyber.

While resilience and reversionary are the words that spring to mind and, of course, they have an important role, it is axiomatic that operations are going to happen alongside cyberattacks against space assets. It is highly likely that those operations will not sit comfortably under the umbrellas of the right of self-defence or the law of armed conflict and that the grey zone is here to stay; for now, anyway.

It may seem defeatist, but it is probably a truism that there is no way of easily solving the blurred lines and grey zone, so we have to find some other way. With the pace of change of technology, it is not always helpful to look to history for solace.

However, just like our forebears facing new military capabilities, there is considerable value in understanding, scenario testing and rehearsal. In the case of the space-cyber dynamic, this means protecting space assets and, when they can't be protected, exploiting testing scenarios, understanding what is happening, how to react, how to work with it and how to undertake operations in a degraded or denied environment.

Armed with these insights, exercising serves to hone the skills of those required to operate effectively in the absence of, or with degraded, space products – as alluded to earlier, this fundamental war-gaming concept would be familiar to those who have gone before.

The Value of an Emulated Environment

Exploring ways to operate effectively in an environment where critical space services are denied or degraded is not something you would ideally do in a live environment. It is expensive and difficult to do at scale.

In most cases, it is also impossible to forensically examine a satellite following an attack in order to understand what happened. Fortunately, there is an inexpensive, scalable and effective way of generating the required understanding, scenario testing and rehearsal, and one that does not impact on the primary purpose of orbital and ground assets — a space cyber-range.

Space is totally reliant on cyber. Space architecture is, with very few exceptions, managed, connected, controlled and exploited via the medium of cyberspace. This means we can precisely recreate space (and other domain) architectures in a virtual environment, using software – and sometimes, if required, hardware – modules to simulate real assets.

This allows us to interact with any space architecture and its assets in a safe and secure virtual environment. More importantly, we can interfere with the emulated architecture and be as intrusive as we want while testing and practicing responses to attacks.

In addition, non-space assets can be connected and integrated into the cyber test and evaluation setup in a holistic and enterprise level way. These could be critical national infrastructure (CNI) nodes and assets, for example.

Cyber-ranges, whether including space assets or not, are not limited to threat, vulnerability and mitigation analysis. They are also perfectly suited to planning and rehearsing missions and activities, testing new concepts and capabilities, and assessing the integration of digital assets.

Securing Space Products for Defence

At a time when providing space capabilities are shifting from the preserve of governments to the private sector, there is an increasing need to use cyber to secure space assets, including orbital, ground, links and people.

Specifically, in defence terms, we need to secure those space products upon which we rely. As an example, RHEA Group provides such a capability for the European Space Agency, based in Redu, Belgium. The first dedicated cyber-range for space, the facility provides the capability to create virtual architectures, including space and, when required, non-space assets emulation. This enables operator training and system of systems testing and evaluation, and provides a safe and secure setting to understand and successfully manage space operations in a hostile cyber environment.

The ability to understand and protect our own space assets and capabilities from cyber threats is essential, as is the need to operate successfully in a degraded or denied environment. This type of war-gaming approach is not new, but the application of the synergies between space and cyber at least allows us to accurately replicate space in a safe and secure virtual environment.

In a sense, the synthetic emulation of the space environment can be more holistic than other environments, allowing a cyber-range to provide a very authentic platform to understand, scenario test and rehearse, thereby underpinning a defensive position.

www.rheagroup.com

Mark Roberts is the Defence and Security lead for RHEA Group in the UK, having joined the company in January 2019. Previously, Mark undertook a variety of lead consultancy roles in the defence, security, energy, education and transportation sectors with Atkins. He was Operations Director for Atkins Security Business before moving into Business Development in 2016. Mark is the Project Director for the Spaceport 1 Consortium, developing a vertical launch capability in the Outer Hebrides. He is also a member of the Faculty of the London Institute of Space Policy And Law. Before moving into the commercial world, Mark was in the Royal Air Force, where he was an operational pilot and commanded both 12 Squadron and RAF Lossiemouth. Mark was Director of the Air Staff in MoD (2007-2010) with Space and Cyber Policy in his portfolio, and Head of Capability Deep Target Attack, with responsibility for Combat Air, Complex Weapons, Land Engagement and elements of the Queen Elizabeth class carrier programme.





COTM EMPOWERS WARFIGHTERS

A Government Satellite Report by Robert Rigsby, Senior Director COCOMs and Integrated Development, SES-GS

Ensuring definitive strategic advantages against adversaries is a continual military challenge, especially in rapidly changing environments. Today, many of the platforms and applications that give the warfighter an edge are network-enabled.

As military operations and platforms continue to grow increasingly dependent on IT systems and applications, it is essential that warfighters remain connected. That can be a problem in theater, where terrestrial networks often do not exist, can be compromised, or are simply untrusted.

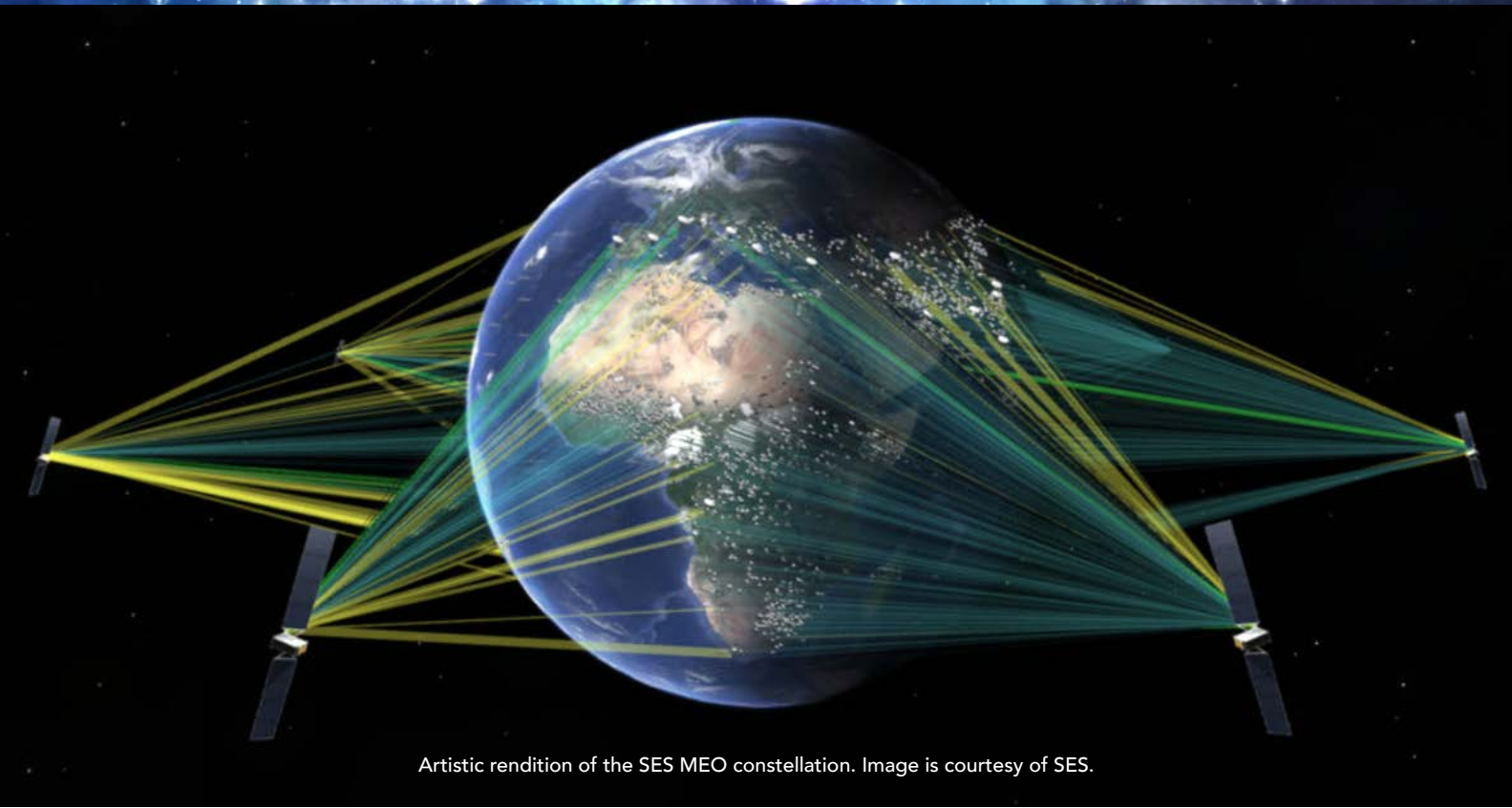
To address some of the challenges of keeping troops ubiquitously connected, the military has traditionally turned to satellites to deliver communications and connectivity to deployed warfighters. But the size and weight of ground infrastructure and terminals — and challenges caused by limited throughputs and high latency — have often kept satellites from providing connectivity and communications. This is especially true for warfighters that are on the move.

Soldiers need mobility. They also could benefit from network-enabled capabilities on the move. However, they do not need the increased weight of large, heavy satellite terminals, and antennas, nor

their large power requirements. This is a problem because there are critical advantages of an empowered soldier with access to advanced mission command capabilities across all warfighting functions, near real-time decisiveness, and the ability to mature capabilities in theater.

When soldiers are away from the forward operating base, it would be incredibly useful for them to have the same access to applications and IT capabilities that they have on base. Situational awareness applications in the hands of our warfighters is critical. Access to cloud data and services, geo intelligence, full communications, including voice, text, and video represent key advantages that will be available to keep warfighters connected and informed.

Thankfully, new satellite hardware — including flat panel, Electronically Steerable Array (ESA), and phased array antennas — is entering the marketplace that is reducing the size and weight of satellite ground infrastructure and hardware. Unfortunately, these flat panel, ESA and phased array antennas are not as effective as traditional parabolic antennas.



Artistic rendition of the SES MEO constellation. Image is courtesy of SES.

However, stronger, more concentrated beams are helping to counter that problem. Major satellite advancements could lead to high bandwidth communications being available to warfighters on the move.

One of these new advancements involves the construction and launch of a new generation of satellite that is capable of delivering massive throughputs from the Medium Earth Orbit (MEO). This new satellite service, O3b mPOWER, is slated to be available early in 2022, and will be launched and operated by satellite communications provider SES.

The sheer power of these satellites makes it possible to address one of the largest stumbling-blocks to using satellite for Comms-On-The Move (COTM) in the past — the size of the antenna and ground hardware. With such a powerful satellite, it is now possible to employ smaller, flat panel, phased array antennas that track satellites through the sky. This means that the size and weight of satellite hardware is no longer a limiting factor. Such advancements, and the use of O3b MEO and O3b mPOWER, will allow the military to bring to bear empowered, informed, and nimble warfighters and maintain a significant advantage in combat theater.

O3b mPOWER also employs digital beams that are customizable and steerable. This gives customers the ability to determine the size of the pipe based on present requirements. Coupled with the reduced latency, this allows for all “at-home” technologies to be employed for expeditionary and mobile communications.

Today’s warfighter is facing a new generation of near-peer adversary. To gain and keep a tactical edge over these adversaries, the DoD is moving towards a hyper-enabled warfighter that relied on network-enabled platforms and capabilities.

Satellite is essential for delivering the necessary connectivity for these systems, but that has traditionally come with limitations that hampered the ability to truly embrace comms on the move. Thanks to O3b mPOWER and a new generation of ground hardware, those limitations are being erased and true, high throughput comms on the move are about to become possible.

ses-gs.com

For additional information about O3b mPOWER and what it can do for the military, [select this direct link.](#)

This article first appeared on GovSat and is republished with permission.

Author Robert Rigsby is the Senior Director COCOMs and Integrated Development with SES-GS.



A SPACE FOUNDATION EXECUTIVE SUMMARY

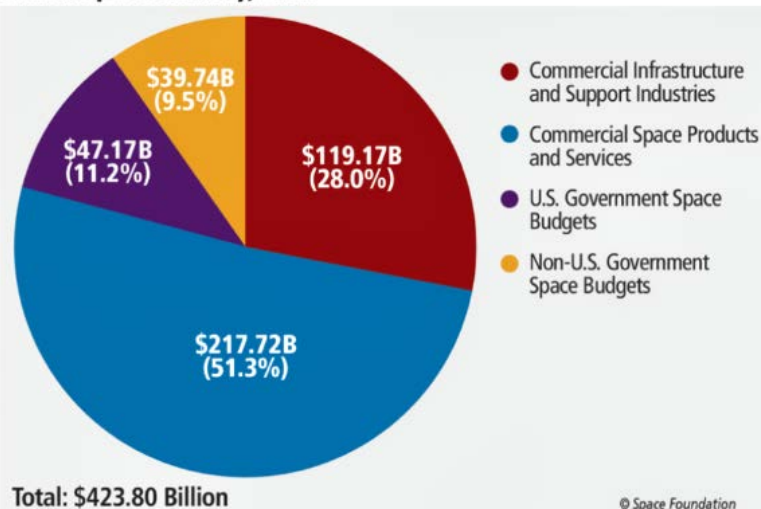
THE SPACE REPORT 2020 Q2

The Space Report 2020 Q2 provides a comprehensive analysis of the 2019 global space economy and examines in detail government and military spending by dozens of nations worldwide.

Space Foundation's Research & Analysis team spent months gathering data from space agencies and governments around the world, compiled the data, and evaluated trends by nations, agencies, and sectors. According to that research, the global space economy climbed to \$423.80 billion in 2019, up 2.2 percent over 2018 and expanding 73 percent over the past decade.

The gains shown in the last decade do not capture the economic instability that has rocked global markets since January 2020, when the coronavirus grew into a worldwide pandemic. While markets have shown initial effect in the first half of 2020, comparative annual analysis will not be available until 2021.

Global Space Activity, 2019



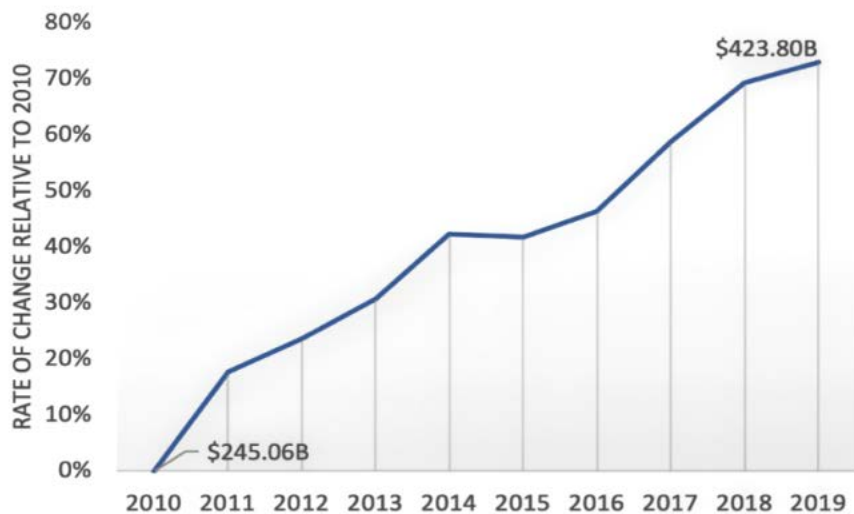
Space Economy

Commercial revenue climbed to \$336.89 billion in 2019, up 6.3 percent from \$328.86 billion in 2018. A large driver of that activity was in space infrastructure and support industries, which climbed to \$119.17 billion — a 16.1 percent increase over 2018's \$102.66 billion. The 2019 total marks the first time since 2016 that the sector exceeded the \$100 billion mark.

Space products and services, a sector of commercial space revenue, totaled \$217.72 billion, easing up 1.7 percent from 2018's \$214.18 billion.

Nations and international government organizations collectively contributed \$86.9 billion to the global space economy. This is a 16 percent increase over the last decade.

Global Space Economy, 2010-2019



Source: Space Foundation Database

U.S. government space budgets totaled \$47.17 billion last year. Despite significant policy and program priorities, U.S. space budgets grew 1 percent during the last decade.

NASA funding in 2019 increased by 3.7 percent, growing to \$21.5 billion from a 2018 total of \$20.7 billion. The 2019 total is the highest real-year figure in NASA history.

Non-U.S. government spending in 2019 totaled \$39.74 billion, a 7.7 percent increase from 2018 and a 54 percent increase over the decade. Civil-sector spending, which represents 76 percent of non-U.S. space spending, totaled \$30.2 billion, a 10.6 percent increase over 2018.

an increase of 2.4 percent from 2018. In Japan, total employment for 2018, the latest year data is available for private industry, was 10,390.

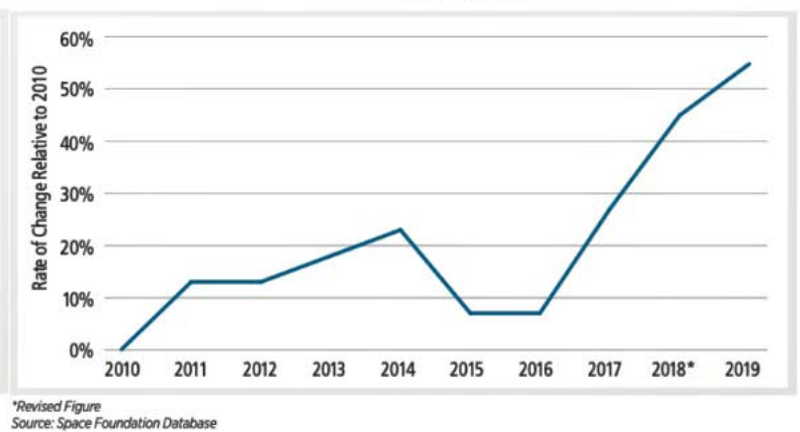
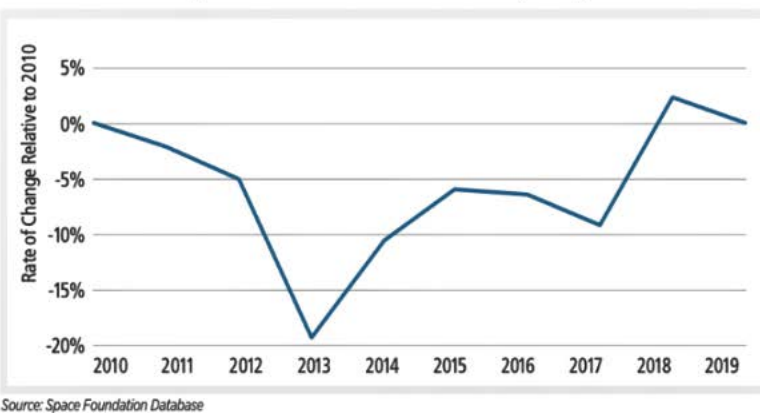
U.S. Hiring in 2020

The U.S. Bureau of Labor Statistics provides monthly reports that include some broad data relating to more general job sectors that contain specific space industry jobs as identified by codes established by the North American Industry Classification System (NAICS).

Based on 12 NAICS codes that have some broad affiliation with the space industry, U.S. job loss from December 2019 to May 2020 has totaled 241,600, according to data from the U.S. Bureau of Labor Statistics.

Two NAICS codes more specific to the space industry — Guided Missiles, Space Vehicles and Parts (NAICS Codes 336414,5,9) and

Rate of Change in U.S. Government (left) and non-U.S. Government Space Spending (right), 2010-2019



Space Workforce

Space Foundation research also determined that in 2019, European countries were investing financially and in workforce development as well.

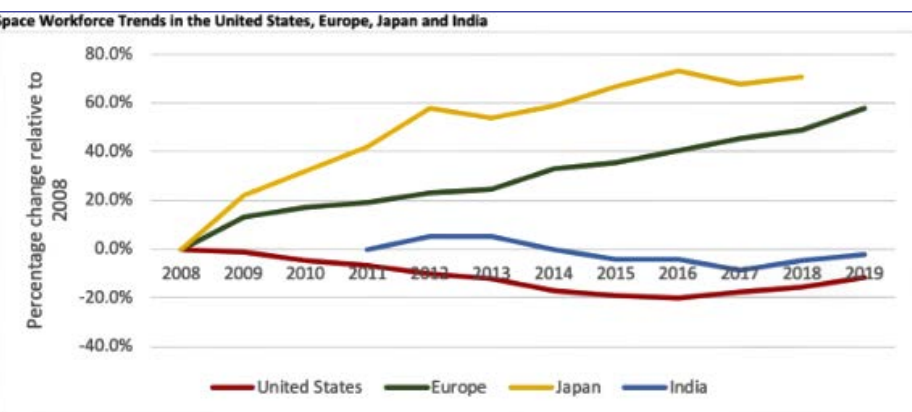
The European space workforce included an estimated 47,895 employees working on design, development, and manufacturing of space assets. This is 6.2 percent larger than 2018, when the workforce included 45,117. The workforce in the U.S. grew by 2 percent in 2019 to 183,000. India's space workforce employed 17,222 people in 2019,

Search, Detection and Navigation Instruments (NAICS Code 334511) — have grown by 1,400 jobs from December to May. Inquiries to some of the larger launch companies also reflect hiring increases during the pandemic.

Space Infrastructure

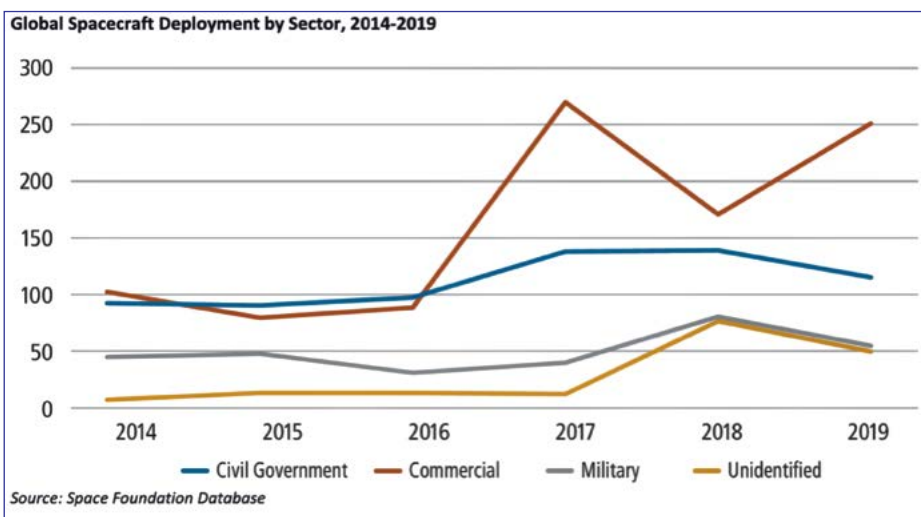
Spacecraft deployment numbers rose by five in 2019, increasing slightly to 466 last year. These spacecraft were deployed from 97 successful launches, including from the International Space Station (ISS). Commercial missions saw the largest share of deployments, accounting for 54 percent of launched spacecraft (251). Spacecraft on commercial missions increased 48 percent from 170 spacecraft launched in 2018.

The next-highest share went to civil government missions, with 25 percent (114) of spacecraft deployed for that sector in 2019. That is a 5 percent decrease from 2018's 30 percent share of civil government spacecraft, or 138 spacecraft out of the 461 that launched in 2018.



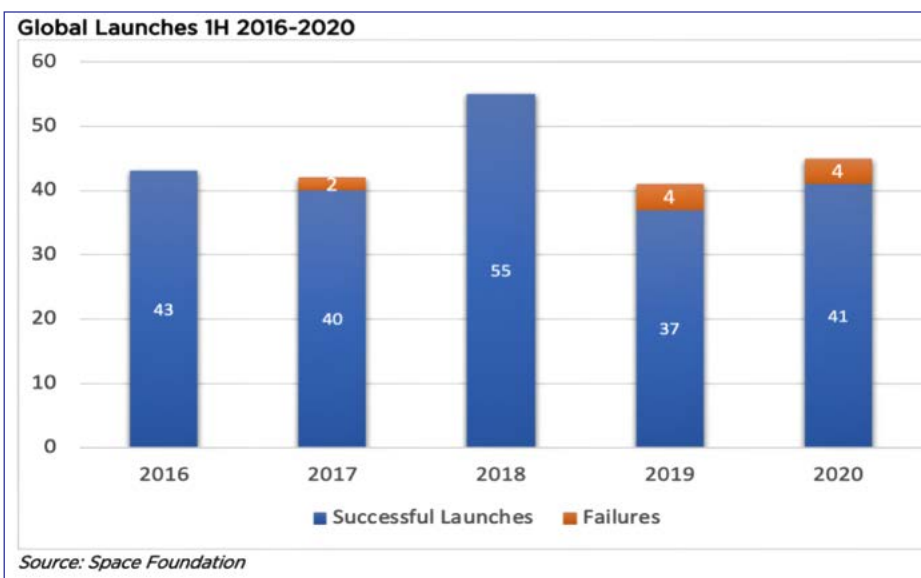
Source: U.S. Bureau of Labor Statistics, Eurospace, Society of Japanese Aerospace Companies, India Department of Space. Note: 2019 employment data for Japan Aerospace companies was unavailable.

The military mission segment accounted for only 11 percent (53) of all spacecraft deployed in 2019, which is down when compared to 2018's 17 percent share, with 78 deployed.



2020 Launch Update

Despite a global pandemic, launches for the first half of 2020 were on par with previous years. The 41 successful launches were just slightly below the five-year average of successful launches which is 43.2.



Space Foundation's Research & Analysis team produces *The Space Report*, and earlier this year transitioned its annual summary into quarterly updates of global space activity. This new format makes it possible to

provide the most up-to-date information on space infrastructure, facilities, launches, and programs. Similar to other major economy-measuring indicators that inform our awareness of what is happening around the world, the quarterly installments of *The Space Report* are designed to improve our discussions and understanding of the reach, impact, and health of the space community.

Each quarterly issue of *The Space Report* is available for purchase by the public for \$250. For significant savings, all four quarterly issues can be purchased as a bundle for \$499. For continuously updated information or historical data on the topics covered by the report, please subscribe to *The Space Report Online*. The online service also provides subscribers with searchable access to all the research conducted for *The Space Report* dating back to 2005. The full PDF is available for free to subscribers of *The Space Report Online*.

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For questions related to *The Space Report* content or the space industry in general, or to request customized research by our Research & Analysis team, please contact Research@SpaceFoundation.org.

The Space Report is widely recognized as the definitive body of information about the global space industry. It contains worldwide space facts and figures and is illustrated with photographs, charts and graphs detailing the benefits of space exploration and utilization, the challenges facing the space sector, opportunities for future growth, and the major factors shaping the industry. *The Space Report* serves as a resource for government and business leaders, educators, financial analysts, students, and space-related businesses. For over a decade, *The Space Report* has chronicled the growth of the space community from around the world.

